PROC. ENTOMOL. SOC. WASH.
84(1), 1982, pp. 16–22

SIX *TRICHOGRAMMA* (HYMENOPTERA: TRICHOGRAMMATIDAE) SPECIES ASSOCIATED WITH A MARYLAND CORNFIELD, WITH DESCRIPTION OF A NEW SPECIES[1,2,3]

KEVIN W. THORPE

Beneficial Insect Introduction Laboratory, IIBIII, Agric. Res. Serv., USDA, Bldg. 417, BARC-East, Beltsville, Maryland 20705; Maryland Center for Systematic Entomology, Department of Entomology, University of Maryland, College Park, Maryland 20742.

Abstract.—Trichogramma species occurring along the edge of a 3 ha stand of field corn in the Beltsville Agricultural Research Center, Beltsville, Maryland, were surveyed during the 1980 season by maintenance of *Heliothis virescens* (F.) egg cloths in ten locations. A total of 1931 eggs from 79 egg cloths was parasitized by *Trichogramma* spp. Six species of *Trichogramma* were collected. These species were, in descending order of abundance, *T. minutum* Riley, *T. pretiosum* Riley, *T. exiguum* Pinto and Platner, *T. parkeri* Nagarkatti and ***T. marylandense***, n. sp., and *T. retorridum* (Girault). *Trichogramma marylandense* is described and illustrated.

Trichogramma wasps have been mass reared and released against insect pests for over 70 years (see Ridgway et al., 1981, for a review). Some recent examples of successful biological control of pests with *Trichogramma* are reported by Oatman and Platner (1978) on tomato, Parker (1971) on cabbage, and Ables et al. (1979) on cotton. However, in spite of recent advances in *Trichogramma* taxonomy (Nagarkatti and Nagaraja, 1971; Pinto et al., 1978), which have made possible the accurate identification of most of the known North American species, little effort has been made to determine the endemic species of *Trichogramma* in agricultural areas. Surveys of *Trichogramma* species are now needed to obtain information on their distribution,

---

[1] Scientific Article No. A2970. Contribution No. 6030 of the Md. Agric. Exp. Stn., College Park.

[2] From a dissertation to be submitted to the Graduate School, University of Maryland, by the author in partial fulfillment of the requirements for the Ph.D. degree in Entomology.

[3] Mention of a commercial product in this paper does not constitute an endorsement of this product by the USDA.

biology, and ecology so that their potential for use as biological control agents can be evaluated.

During 1980 and 1981 I surveyed the species of *Trichogramma* occurring in and around a field of corn at the Beltsville Agricultural Research Center, Beltsville, Maryland. My objectives were to determine what species were present and to obtain information on their relative abundance.

MATERIALS AND METHODS

In 1980 I surveyed the *Trichogramma* species by placing ten strips of cloth (except on sampling dates 1 and 2 when only two cloths were used), each containing ca. 100 naturally oviposited *Heliothis virescens* (F.) eggs, in ten locations around the perimeter of a 3 ha stand of field corn. Four of the locations were adjacent to a 0.2 ha plot of sweet corn (variety NK199) within the larger field. The phenology of the corn was as follows: The field corn was planted 27 May, tasseled 21 July, was in silk from 29 July to 8 August, and was machine harvested 22 September; the sweet corn plot contained staggered plantings so that all stages of growth were continuously present. Sweet corn was planted on 30 May and every week thereafter. The first planting tasseled on 10 July and was in silk from 18 to 28 July. The sweet corn was not harvested.

Egg cloths were maintained in the sample area from 7 May to 7 November 1980. The cloths were attached to a 5 cm wire ringed with Tanglefoot® to limit access to egg predators and then suspended from stakes or branches at a height of ca. 1 m. The egg cloths were replaced every 3–5 days and held in the laboratory for emergence of parasitoids. Prior to use all *H. virescens* eggs were killed by exposure to ca. 30 krad of gamma radiation. Identifications were made in collaboration with Carll Goodpasture, formerly of the Beneficial Insect Introduction Laboratory, IIBIII, ARS, USDA.

In 1981 a 0.2 ha plot of soybeans replaced the 0.2 ha sweet corn plot. The 3 ha field was again planted to field corn. I continued the survey by concentrating 45 egg cloths in and around the soybean plot.

The description of the *Trichogramma* species (except color characters) is based on 15th-generation adults from a culture started in 1980 and 6th-generation adults from a culture started in 1981. Both cultures were maintained at 20–25°C. The adults were preserved on glass slides in Hoyer's medium. The terminology used is that of Pinto et al. (1978). Quantitative data listed in the description are those of the holotype (male) or allotype followed (in brackets) by the mean, standard error, and range of that same character measured on 30 additional specimens. (All characters are not from the same 30 specimens since all characters are not clearly visible on all specimens.) Description of color is based on freshly killed 15th-generation adults from the 1980 culture. Since rearing temperature has been shown to affect color (Kwangtung Collaborative Research Group of Biological Control of Rice Pests, 1974), these insects were reared for at least two generations at 27°C, 70–80% RH, and constant light.

Results and Discussion

A total of 1931 eggs on 79 egg cloths was parasitized by *Trichogramma* in 1980. Dates of parasitization ranged from 12 May (first sample) to 21 October. Six species of *Trichogramma* were reared from these eggs. These species were, in descending order of abundance, *T. minutum* Riley (36), *T. pretiosum* (Riley) (31), *T. exiguum* Pinto and Platner (16), *T. parkeri* Nagarkatti (3) and *T. marylandense*, n. sp. (3), and *T. retorridum* (Girault) (1). Figure 1 shows the number of cloths with eggs parasitized by each species on each sampling date. Unfortunately, parasitism of eggs on a single cloth by more than one female cannot be detected unless the females are of different species, since their progeny are otherwise indistinguishable. *Trichogramma minutum*, *T. pretiosum*, and *T. exiguum* were collected much more frequently than were the other three species and were collected throughout the entire season, whereas the latter three species were collected only briefly early in the season. The one exception was the collection of *T. marylandense* in September, when parasitism was at a marked peak. Different eggs on the same cloth were parasitized by two different species of *Trichogramma* on 11 occasions (*T. minutum*/*T. pretiosum*, 5; *T. minutum*/*T. exiguum*, 4; *T. pretiosum*/*T. exiguum*, 1; *T. pretiosum*/*T. marylandense*, 1). On two occasions individuals of two species emerged from the same egg (*T. minutum* ♂ and *T. exiguum* ♂; *T. minutum* ♀ and *T. pretiosum* ♀).

The 1981 survey is not yet completed, however specimens of *T. marylandense* collected in 1981 are included in the material examined for the description. *Trichogramma marylandense* was collected on 13 July, 20 July, and 17 August 1981, and sampling is continuing.

One of the objectives of the 1980 study was to determine the relative abundance of the *Trichogramma* species in the survey area. However, the number of females of each species sampled may not reflect their abundance. Differences in host acceptability and microhabitat preference could affect sample size. The discovery of six sympatric *Trichogramma* species all attacking the same host (in this case an artificially provided host) should serve to emphasize the need for basic ecological studies of *Trichogramma* species. An understanding of such specific characteristics as habitat and host preference is essential to biological control programs involving species of this genus.

Trichogramma marylandense **Thorpe, New Species**

Figs. 2–4

Type-data.—Holotype adult ♂ on slide with two other specimens under separate coverslips; holotype nearest right margin of slide with right label

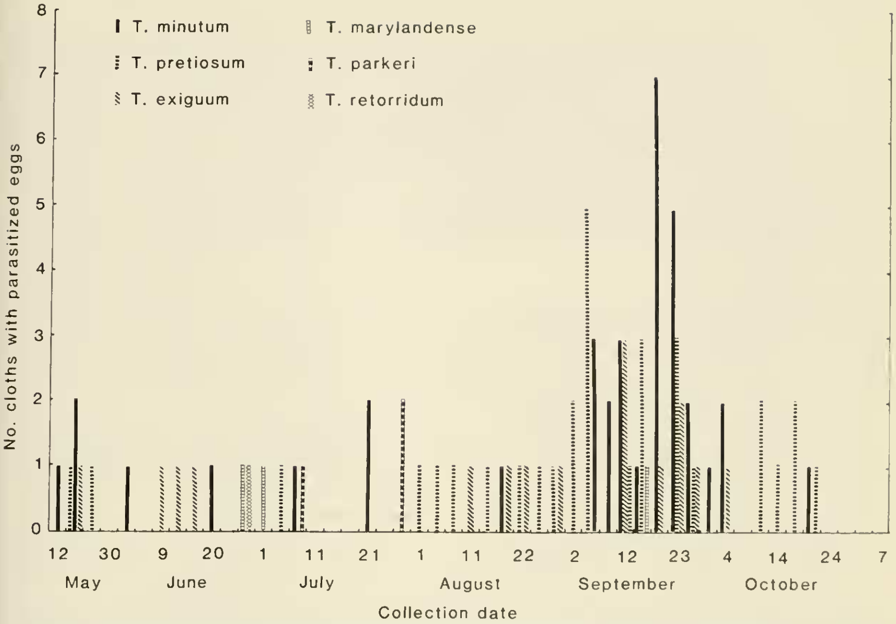
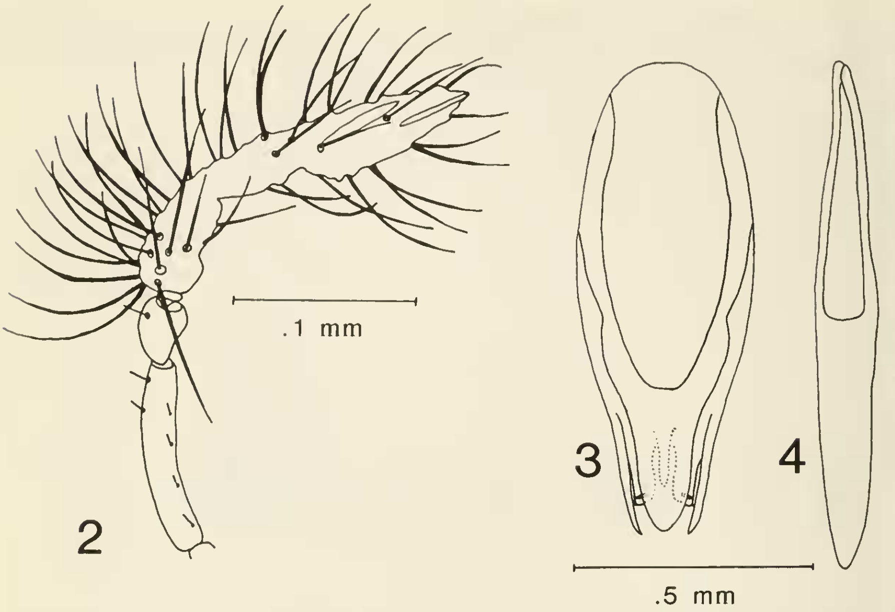


Fig. 1. Number of cloths with *Heliothis virescens* eggs parasitized by *Trichogramma* spp. on each collection date, Beltsville, Maryland, 1980.

"*Trichogramma marylandense* Thorpe, Beltsville, Md. 12-4/1, mounted 31 XII 80, F15 lab culture, ex. *Heliothis virescens* egg cloth, coll. 26 VI 80, K. Thorpe, Hoyers." Allotype adult ♀ on slide with two other specimens under separate coverslips, same label; allotype center specimen. There are 145 paratypes (80 ♂, 65 ♀), 94 of which (50 ♂, 44 ♀) are on 32 slides all with same data as holotype. Remaining 51 paratypes (30 ♂, 21 ♀) are on 17 slides with right label "*Trichogramma marylandense* Thorpe, Beltsville, Md. 20-3-2, mounted 1 IX 81, F6 lab culture, ex. *Heliothis virescens* egg cloth, coll. 13 VII 81, K. Thorpe, Hoyers." Holotype (USNM type no. 100087) and allotype are deposited in the collection of the National Museum of Natural History, Washington, D.C.

Holotype male.—Eye and ocelli red; antenna and head yellow; thorax yellow with black pronotum and mesoscutum; legs yellow except meso- and metacoxae, metafemur, and 3rd tarsal segments black; wings clear with smokey patch extending from base to even with distal end of stigma; 1st abdominal segment yellow, remaining segments black.

Antenna (Fig. 2) with flagellum (excluding annellus) relatively long and curved, 0.16× as wide as long (0.032 mm × 0.199 mm) [0.17 ± 0.002; 0.15–0.19], 1.21× as long as metatibia (0.165 mm) [1.20 ± 0.005; 1.15–1.27], with 2 distinct constrictions, flagellar setae moderately long, tapering gradually



Figs. 2–4. *Trichogramma marylandense*, holotype male. 2, Antenna. 3, Genital capsule. 4, Aedeagus.

from base, 46 in number [46.6 ± 1.63; 41–55], longest 2.46× as long (0.078 mm) as maximum width of flagellum [2.37 ± 0.03; 2.07–2.75].

Forewing with vein tracts well defined, area between 4th and 5th vein tracts with 34 setae [28.5 ± 0.81; 22–38], longest seta on postapical wing margin 0.12× as long as maximum wing width (0.032 mm and 0.267 mm) [0.13 ± 0.003; 0.10–0.18). Hindwing with posterior vein tract extending ⅓ to ½× the distance of middle tract; anterior tract of 1–4 setae extending less than ⅓ distance of middle tract.

Mesoscutellum with anterior setae 0.25× as long as posterior setae (0.010 mm and 0.039 mm) [0.28 ± 0.012; 0.19–0.50].

Genital capsule (Fig. 3) 0.37× as wide as long (0.036 mm × 0.099 mm) [0.37 ± 0.003; 0.33–0.39]; dorsal expansion of gonobase (DEG) shallowly constricted at base, sides concave, width at base (0.023 mm) 0.64× the width of genital capsule [0.71 ± 0.016; 0.53–0.93]; DEG (0.102 mm long) extending 1.02× the length of genital capsule [0.97 ± 0.006; 0.92–1.03]; chelate structures (CS) (0.095 mm long) extending 0.95 the length of genital capsule [0.91 ± 0.008; 0.82–0.97]; median ventral projection (MVP) (0.090 mm long) long and slender, sharply pointed apically, extending 0.90× the length of genital capsule [0.89 ± 0.004; 0.83–0.92]; aedeagus (Fig. 4) (0.112 mm long) 0.68× as long as metatibia [0.66 ± 0.006; 0.58–0.73], 1.12× as long as genital capsule [1.12 ± 0.004; 1.08–1.16]; apodemes (0.053 mm long) comprising 0.48× length of aedeagus [0.50 ± 0.009; 0.43–0.61].

Allotype female.—Color as in male except antenna and head yellow shaded with black; mesoscutum yellow.

Forewing area between 4th and 5th vein tracts with 29 setae [28.2 ± 0.78; 19–37]; longest seta on postapical wing margin 0.12× as long as maximum wing width (0.032 mm and 0.267 mm) [0.13 ± 0.002; 0.11–0.16].

Ovipositor 0.88× as long as metatibia (0.153 mm and 0.175 mm) [0.88 ± 0.008; 0.80–0.97].

Remarks.—Males of *T. marylandense* differ from males of most known North American species of *Trichogramma* by having a DEG that is greater than 0.90× the length of the genital capsule. The only other North American species similar to *T. marylandense* in this respect are *T. brevicapillum* Pinto and Platner, *T. fasciatum* (Perkins), *T. julianoi* Platner and Oatman, *T. maltbyi* Nagaraja and Nagarkatti, and *T. retorridum* (Girault). The flagellar setae of *T. brevicapillum* males are much shorter and stouter than those of *T. marylandense* (1.17× longer than the flagellar width in *T. brevicapillum* (Pinto et al., 1978) compared to 2.37× longer in *T. marylandense*). The DEG of *T. marylandense* males is narrower at its apex than the distance across the gonostyli, which distinguishes it from *T. fasciatum* males in which the DEG is broader at its apex than the distance across the gonostyli (Pinto et al., 1978). The genital capsule of *T. julianoi* is very similar to that of *T. marylandense* but can be distinguished by the length of the apodemes of the aedeagus (0.80× the length of the aedeagus (Platner and Oatman, 1981) compared to 0.50× the length of the aedeagus in *T. marylandense*). *Trichogramma maltbyi* males differ from *T. marylandense* males by having the DEG narrower at its base (ca. ½ genital capsule width in *T. maltbyi* (Nagaraja and Nagarkatti, 1973) compared with 0.71 in *T. marylandense*) and by having longer antennal setae (nearly 4× the flagellar width (Nagaraja and Nagarkatti, 1973) compared with 2.37× in *T. marylandense*). *Trichogramma retorridum* males can be separated from *T. marylandense* males by their very short, suboval flagellum (0.43× as wide as long (Pinto et al., 1978) compared to 0.17× as wide as long in *T. marylandense*). The male genital capsule of *T. marylandense* is very similar to that of the Indian species *T. achaeae* Nagaraja and Nagarkatti (1969). However, the latter species has a minute and inconspicuous MVP, whereas the MVP in *T. marylandense* is long and slender and attains 0.89× the length of the genital capsule. Also, in *T. achaeae* the aedeagus and apodemes together attain less than the length of the genital capsule while in *T. marylandense* they attain 1.12× its length.

Hosts and distribution.—Original specimens of *T. marylandense* were reared from *Heliothis virescens* eggs artifically placed on the edge of a corn field in Beltsville, Maryland on 23 June, 26 June, and 12 September 1980, and from eggs placed in and near a soybean field at the same location on 13 July, 20 July, and 17 August 1981. At present these are the only known collections of this species. Natural hosts are unknown.

ACKNOWLEDGMENTS

I thank Eric Grissell, Systematic Entomology Laboratory, IIBIII, USDA, and Akey C. F. Hung and David L. Vincent, Beneficial Insect Introduction Laboratory, IIBIII, USDA, for their critical review of the manuscript.

LITERATURE CITED

Ables, J. R., S. L. Jones, R. K. Morrison, V. S. House, D. L. Bull, L. F. Bouse, and J. B. Carlton. 1979. New developments in the use of *Trichogramma* to control lepidopteran pests of cotton. Proc. Beltwide Cotton Prod. Res. Conf. 3 pp.

Kwangtung Collaborative Research Group of Biological Control of Rice Pests, Kwangtung Province. 1974. The control of rice leaf roller, *Cnaphalocrocis medinalis* Guenee by trichogrammatid egg parasites. (In Chinese with English summary.) Acta Entomol. Sinica 7(3): 269–280.

Nagaraja, H. and S. Nagarkatti. 1969. Three new species of *Trichogramma* from India. Entomophaga 14(4): 393–400.

———. 1973. A key to some new world species of *Trichogramma* (Hymenoptera: Trichogrammatidae), with descriptions of four new species. Proc. Entomol. Soc. Wash. 75(3): 288–297.

Nagarkatti, S. and H. Nagaraja. 1971. Redescriptions of some known species of *Trichogramma* (Hymenoptera: Trichogrammatidae) showing the importance of the male genitalia as a diagnostic character. Bull. Entomol. Res. 61: 13–31.

Oatman, E. R. and G. R. Platner. 1978. Effect of mass releases of *Trichogramma pretiosum* against lepidopterous pests on processing tomatoes in Southern California, with notes on host egg population trends. J. Econ. Entomol. 71(6): 896–900.

Parker, F. D. 1971. Management of pest populations by manipulating densities of both hosts and parasites through periodic releases, pp. 365–376. *In* Huffaker, C. B., ed., Biological Control. Plenum Press, N.Y. 511 pp.

Pinto, J. D., G. R. Platner, and E. R. Oatman. 1978. Clarification of the identity of several common species of North American *Trichogramma* (Hymenoptera: Trichogrammatidae). Ann. Entomol. Soc. Am. 71(2): 169–180.

Platner, G. R. and E. R. Oatman. 1981. Description of a new species of *Trichogramma* (Hymenoptera: Trichogrammatidae) from New York. Proc. Entomol. Soc. Wash. 83(1): 164–167.

Ridgway, R. L., F. R. Ables, C. Goodpasture, and A. W. Hartstack. 1981. *Trichogramma* and its utilization for crop protection in the U.S.A., pp. 41–48. *In* Coulson, J. R., ed., Proceedings of the Joint American-Soviet Conference on the Use of Beneficial Organisms in the Control of Crop Pests. Entomol. Soc. Amer., College Park, Md. 62 pp.